GANARASKA REGION CONSERVATION REPORT 1966

A supplement to The Ganaraska Report
1944

ONTARIO

DEPARTMENT OF ENERGY AND RESOURCES MANAGEMENT

CONSERVATION AUTHORITIES BRANCH

DEPARTMENT OF ENERGY AND RESOURCES MANAGEMENT

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TORONTO

INTRODUCTION

This report on forests and wildlife has been prepared as a supplement to the original report entitled "A Report on the Ganaraska Watershed", prepared by Dr. A. H. Richardson and published jointly by the Dominion and Ontario Governments in 1944. The original report embraced all the renewable natural resources of the Ganaraska watershed but no detailed work was done on the fish and wildlife of the area.

In 1962 the Ganaraska Authority was enlarged to include the watersheds of Wilmot Creek and other small streams flowing into Lake Ontario between Wilmot Creek and the Ganaraska River and the name of the Authority was changed to the Ganaraska Region Conservation Authority.

The wildlife section covers the new area, as well as the Ganaraska watershed itself, for the reason outlined above. However, the forest section covers only the new portion lying outside the Ganaraska watershed. The main forestry recommendation in the original report was that:

> "Twenty thousand acres of marginal and submarginal land in the northern section of the watershed be withdrawn from agriculture by purchase or expropriation and formed into a protection forest."

The Ganaraska Authority is to be congratulated on the fact that, since it was established in 1946, a total of 8,320 acres have been acquired. In addition the Durham County Forest comprises 1,400 acres in the Ganaraska watershed.

- A. S. L. BARNES

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Technical Staff

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RECOMMENDATIONS

RECOMMENDATIONS

STATED OR IMPLIED IN THIS REPORT

Forest

1. That in addition to the 20,000 acres recommended in the original Ganaraska Report, the Ganaraska Region Conservation Authority Forest be expanded through a definite program of annual additions and planting, until as much as is feasible is acquired of the 9,520 acres mapped for this purpose during the survey of the area west of the main Ganaraska watershed in 1963. (Page 9)

2. That the Authority encourage private reforestation by providing a planting service at nominal cost, and by offering a planting subsidy for trees privately planted. Particular emphasis should be given to those small areas mapped as requiring this service for erosion control through the use of vegetative materials. (Page 11)

3. That the Authority encourage, through the provision of a subsidy or service, the fencing of areas requiring erosion control, in order to allow these areas to revegetate themselves. (Page 11)

Wildlife

4. That, apart from waters used for early put-and-take fishing, the Authority urge the limiting of trout stocking to those waters which are shown in this survey to be suitable for trout, and which are known to have present populations below the carrying capacity of the stream. (Page 11)

5. That the Garden Hill Pond be stocked with brown trout. (Page 11)

6. That the Authority urge the correction of the pollution from:
   (a) the ditch which discharges to the bank of the Ganaraska River on the south side of Barrett Street at Port Hope. (Page 12)
   (b) chemicals which are from time to time being dumped directly into the Ganaraska River. (Page 13)

7. That the Authority improve at least one stretch of publicly owned stream by the methods described, as an example to private owners. (Page 16)

8. That the Authority in selecting areas for acquisition for reforestation give priority to areas which contain trout streams, and in so doing make an agree-

ment with the Department of Lands and Forests for possible improvements on the streams. (Page 16)

9. That the Authority publicize the proper methods for constructing trout ponds as described in this report. (Pages 16 and 17)

10. That the Authority publicize the many methods for improving land for wildlife as described in the report. (Pages 19 and 20)

11. That the Authority urge the restriction of the poisoning of roadside vegetation to those areas where it is absolutely necessary. (Page 23)

12. That the Authority acquire or construct at least two warm water ponds, one for fish and one for wildlife, and that the Authority demonstrate good management techniques on each of these as described in this report. (Page 26)

FOREST

CHAPTER I

SURVEY OF PRESENT WOODLANDS

1. Physiography

A knowledge of the physiographic features of this part of the Ganaraska Region Conservation Authority is useful in providing some insight into the conservation problem that exists in the area. It is also useful in formulating recommendations designed to correct the mistakes brought about by improper land use methods on these features. The most important features are:

(a) The Oak Ridges Interlobate Kame Moraine

(b) The South Slope

(c) The Iroquois Plain

(a) The Oak Ridges Interlobate Kame Moraine

Only a small portion of the kame section of this moraine is included in this part of the Ganaraska Region Conservation Authority. This is the section around New Park and southward in Concessions IX and X of Clarke Township.

Putnam and Chapman* report that much of the interlobate moraine is boulder clay, but the crest is covered with sand hills and coarse outwash. The sand of the moraine contains a great deal of lime. As a soil building material it is fairly high in phosphorous and low in potash content. The till is also high in lime. In gullies and deep road cuts, hard bluish-gray boulder clay often appears. This clay is highly impervious to water.

On Putnam and Chapman's physiographic maps, the interlobate moraine is limited to the sandy crest and shoulders of the main ridge. The South Slope portion contained in this, the western section of the Ganaraska Region, is regarded as a till plain.

(b) The South Slope

This is the southern slope of the interlobate moraine of which the Ganaraska Region section is a central portion. The Ontario and Durham County section is drumlinized, although the drumlins are scattered and are of the long thin type pointing directly up the slope of the moraine. Streams flow directly down the

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* Putnam and Chapman: "The Physiography of Southern Ontario." University of Toronto Press, Toronto, 1951.

South Slope and, being rapid, they have cut sharp valleys in the till. In addition, numerous gullies have been cut by intermittent drainage, so that east-west side roads cross a succession of valleys. Bare gray slopes where soil is actively eroding are common in this area, and the extension of gullies into otherwise unbroken fields is a critical problem. It is a particularly important problem because the land affected is otherwise of high quality.*

(c) The Iroquois Plain

The portion of the Iroquois Plain within the west section of the Ganaraska Region can be described as follows:

> The western portion has a pattern of drumlins and clay plains. "Below the old beach (of Lake Iroquois) lies a strip of poorly drained, sandy boulder pavement.
>
> Eastward of Newcastle, the land becomes somewhat more rugged and the hills formed a group of islands in the old lake. The most marked shoreline swings southward around these islands as a wide gravel beach below which lies an extensive boulder pavement." *

2. The Forest

The Ganaraska Region Conservation Authority lies in the Huron-Ontario section of the Great Lakes - St. Lawrence Forest Region.† Most of the part included in this survey is also within the Whitby site district of the Lakes Erie - Ontario Site Region of Hills' classification.** The site district land form is described in general terms as "a plain of water-laid and ice-laid deposits of clay and loam, moderate to high in lime content".

The prevailing association of trees originally found in this part of the Ganaraska Region Conservation Authority was sugar maple and beech. These were generally associated with the till soils of the South Slope of the moraine. Only a small portion of the new area, in the headwaters of Wilmot Creek, is on the ridge of the actual moraine, where the oaks and some pine and hemlock would be expected to occur more frequently.

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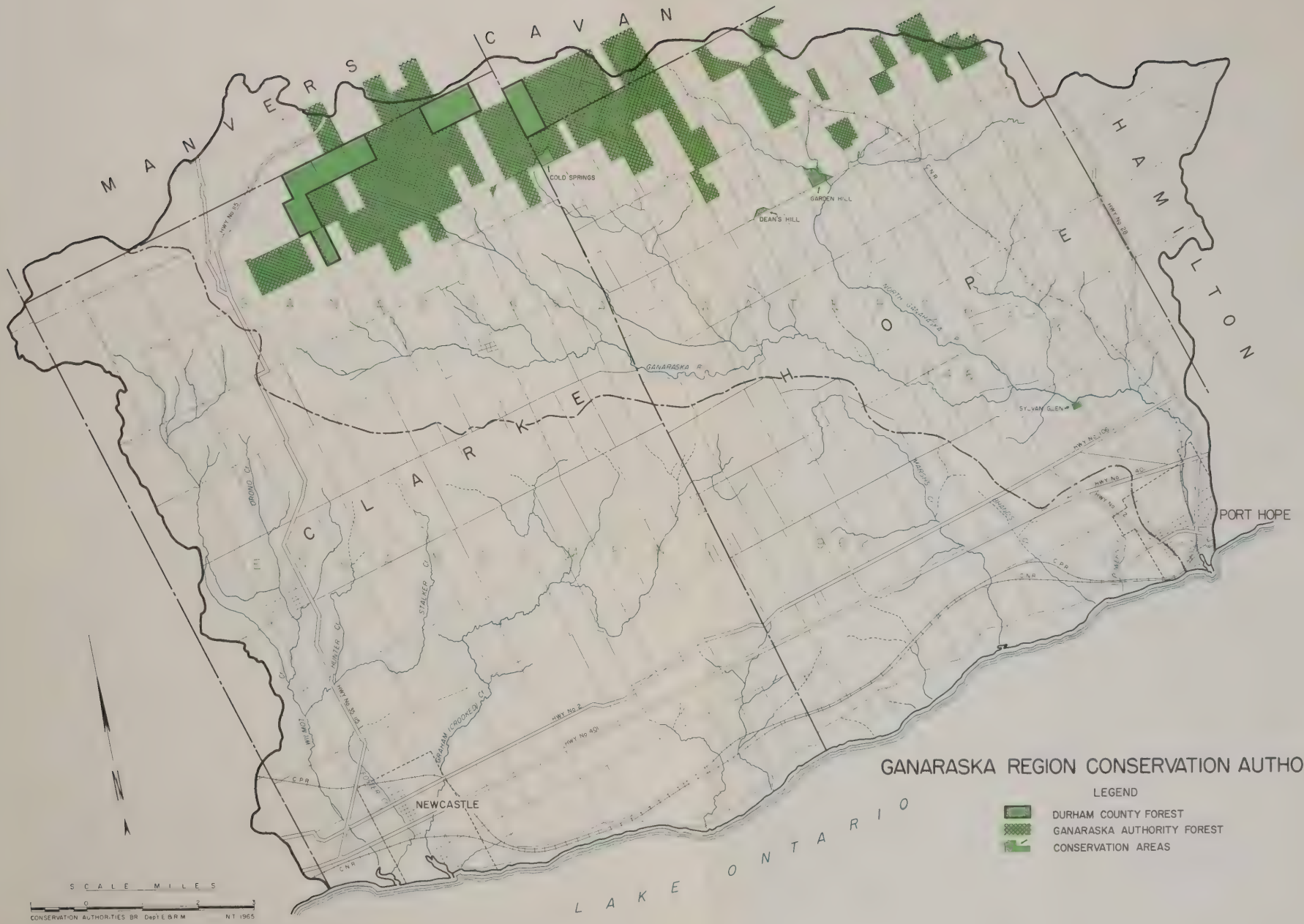
* Putnam and Chapman, op.cit.

† Rowe, J.S. Forest Regions of Canada, Canada Department of Northern Affairs and National Resources, Bulletin 123, Ottawa, 1959.

** Hills, G.A. A Ready Reference to the Description of the Land of Ontario and Its Productivity, Division of Research, Ontario Department of Lands and Forests, Toronto, 1959.



GANARASKA REGION CONSERVATION AUTHORITY

LEGEND

- DURHAM COUNTY FOREST
- GANARASKA AUTHORITY FOREST
- CONSERVATION AREAS

Generally speaking therefore, the climatic and soil conditions of this portion of the Ganaraska Region are those on which the natural forest would be sugar maple and beech with some white and red oak. This is in contrast to the original forest cover on the main Ganaraska River watershed (survey of 1943), where a much higher content of white pine and hemlock occurred because of the preponderance of drier sandy soils and different local topography and climate.

John Squair* describes early conditions as follows:

> "On the best clay loam soils it was essentially a beech and maple forest ... with some admixture of other deciduous woods and some white pine and hemlock. On the lighter, sandy soils there was often a fine growth of hardwood, with a larger mixture, however, of pine and hemlock than on the heavy land. .... On both higher and lower land there was some oak, but that valuable kind of wood was found in greater abundance on the ridges to the north."

He states that as early as 1830 anxiety was expressed over the rapid disappearance of woodlots. Pine was in particular demand for the steamboats plying between Toronto and Quebec. In 1841 alone, 800 masts and 800 immense sticks of squared oak and pine were supplied to the English shipyards. From 1856 on, Newcastle was one of the chief G.T.R. fuel wood depots on the Montreal-Toronto run; beech and maple were the chief types of wood. "Perhaps 1880 might be taken as the date of the end of the cordwood trade at Newcastle."

A large portion of this region is covered by soils associated with smooth undulating limestone till plains formed by glacial Lake Iroquois. These soils are often poorly drained and are frequently characterized by the presence of cedar thickets.

Where drainage is better, some of the lake plain forest cover has been replaced by a well developed orchard industry in the Newcastle area. The climate is relatively cool and humid due to the proximity to Lake Ontario but is still somewhat warmer and more equable than in areas of Eastern Ontario or to the immediate north. This has had a considerable influence on local orchards, and has tended to lengthen the growing season in this region over that of areas on the ridge of the interlobate moraine and farther north.

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* Squair, John. The Townships of Darlington and Clarke, University of Toronto Press, Toronto, 1927.

3. Survey Methods

For the detailed forest survey of the area, aerial photographs taken in 1954, each covering 1,000 acres, were provided for the forestry party. Mapping in the field was done directly on these photographs.

Each area of woodland, scrubland, swamp and rough land was visited and described as to acreage, cover type, presence of grazing, reproduction, and average diameter at breast height. Each woodlot was classified as hardwood, coniferous or mixed. The term "hardwood" is used to denote all broad-leaved trees regardless of their physical hardness. A woodlot in which 80 per cent or more of the trees are hardwoods is called a hardwood stand; one in which 80 per cent or more of the trees are conifers is called a coniferous stand, and all other stands are classed as mixedwood.

Plantations were likewise examined and records made of method of planting, approximate age, care, damage and survival.

Land suitable for reforestation was mapped and descriptions prepared in some detail for the larger areas.

4. Forest Cover Types

Just under 14 per cent of the western part of the Ganaraska Region Conservation Authority is in forest cover of some sort. Most of this forest is along watercourses and in the source areas of the various streams.

The term "forest cover type" refers to those combinations of tree species now occupying the ground, with no implication as to whether these types are temporary or permanent. A slightly modified form of the system drawn up by the Society of American Foresters has been used on this survey so that the system will adequately describe the cover types common to the watershed.

The following cover types were encountered in the western section of the Authority:

Type Number	Name
4	Aspen
6	Paper birch
8	White pine-red oak-white ash
9	White pine
11	Hemlock
14	Sugar maple
24	White cedar
26	Black ash-white elm-red maple
47	Black locust
57	Beech-sugar maple
58	Beech
60	Silver maple-white elm
60a	White elm
88	Willow

Although fourteen cover types were identified during the survey, 86.1 per cent of the woodland is contained in four cover types.

Type 24 - White cedar, occupies 45.8 per cent of the woodland area. Although it is common on the muck soils of local swamps, it is also frequently associated with upland slopes and poorly drained areas that have calcareous soils. It is noticeable that land left vacant in this area of the Authority fortunately tends toward invasion by white cedar rather than wild apple trees, sumac and hawthorn. This tendency is indicated by the large proportion of the area's forest cover occupied by white cedar. Such cedar stands in many cases represent immediate sources of income to local farmers in the form of posts. In addition, the tendency of this species to invade vacant land easily indicates that natural re-seeding of cedar can be expected in areas cut over for posts.

Type 60a - White elm, occupies 15.7 per cent of the woodland area. With its closely related Type 60 (silver maple-white elm), which occupies an additional 3 per cent of the wooded area, it occurs on stream bottoms and on swampy depressions where the land is too wet for agricultural purposes unless completely underdrained. It sometimes spreads out onto slightly drier sites on adjacent pastures.

Type 14 - Sugar maple, occupies 13.3 per cent of the woodland area. It is associated mainly with the better soils of the area, and often owes its prominence to cultural practices favouring maple succession. This type, along with the closely related Type 57 (beech-sugar maple), which occupies an additional 6.3 per cent, originally occupied a considerable area of the better upland soils of Southern Ontario. However, since it occupied the land which was the most suitable for agriculture, it was cleared to make way for that type of land use.

Type 4 - Aspen, occupies 11.3 per cent of the woodland area. It is found mainly on the two portions of this section of the Authority associated with glacial Lake Iroquois.

Although the local market for poplar may be limited, it frequently will provide a suitable site on which to underplant white pine because of the

tendency for the poplar overstory to reduce white pine weevil activity by reason of its shading effect on the young trees.

Other cover types occupying between one and two per cent of the wooded area are Type 26, black ash-white elm-red maple (1.2 per cent) and Type 88, willow (1.3 per cent), both of which are associated with the moist or wet sites of this part of the Authority.

The remaining cover types observed constitute trace types only at the present time.

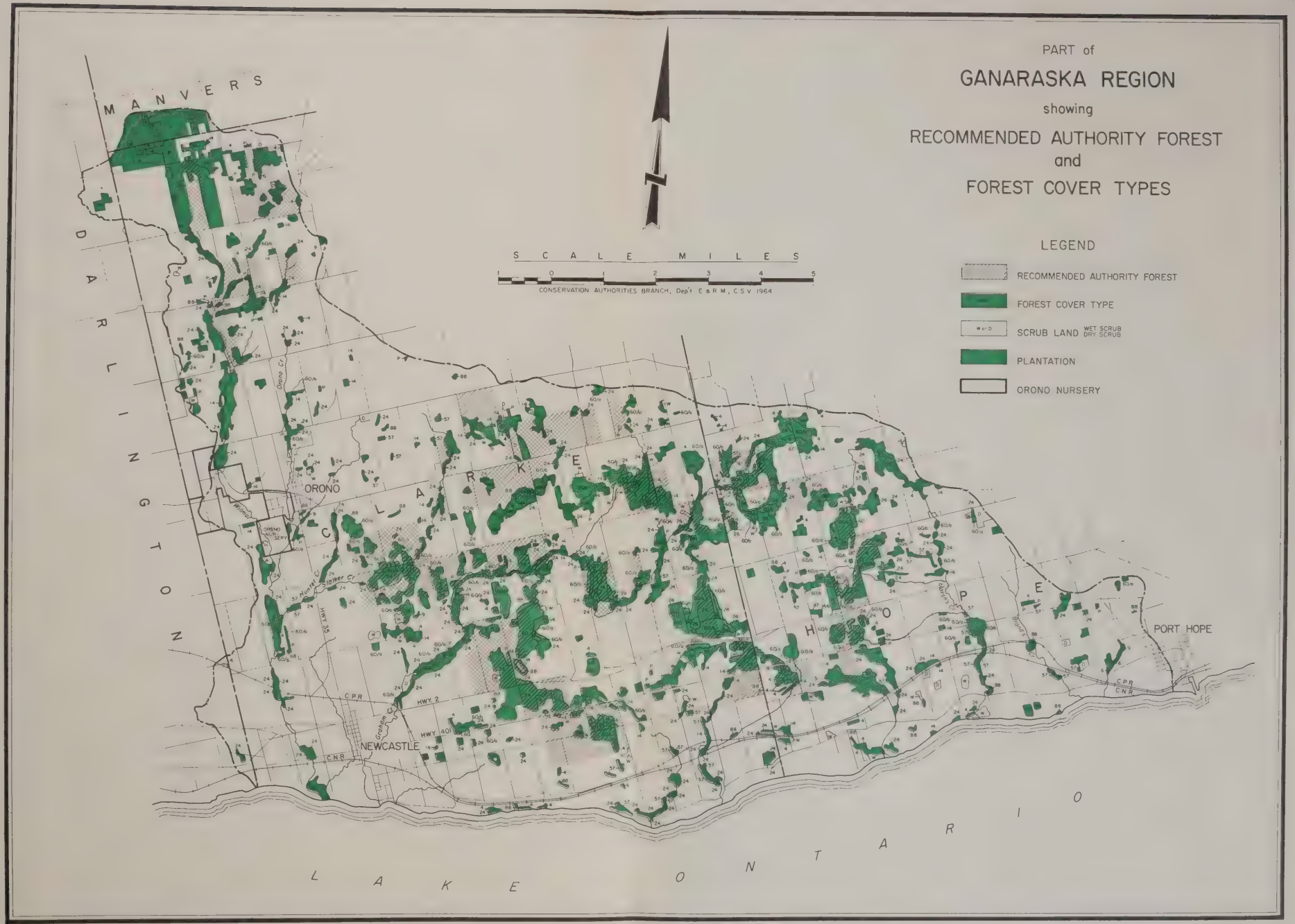
5. Condition of Woodland

As stated previously, about 14 per cent of this section of the Authority is natural woodland. Of this wooded area, about 40 per cent can be classed as hardwood, 20.2 per cent as mixedwood and 39.8 per cent as coniferous.

The results of the survey indicate that none of the natural stands average over 18" in diameter at breast height, the size preferred for sawlogs. However, most of the area's woodland (87.8 per cent) is in the two size classes (4" to 10" d.b.h. and 10" to 18" d.b.h.), that possess a measure of merchantability as posts, poles and pulpwood, and will certainly pay for good management practices in a relatively short time. It might be said that, of the area's hardwood in these two size classes, only the poplar constitutes a major supply of marketable material and this in the form of pulpwood. The other hardwoods are best left to grow into sawlog material in the future. This applies particularly to the hard and soft maples and elm that are presently major local woodlot components. These can also be judiciously thinned to improve overall stand quality in the future, as there is at present a general scarcity of hardwood of good quality in this part of the Authority.

It is the coniferous component (mainly white cedar) in the 4" to 10" d.b.h. range, now occupying 30.3 per cent of the woodland area, that offers the most immediate income producing material, in the form of cedar posts.

Though 56.5 per cent of the area's woodland is uneven-aged, the type of forest that might be expected to produce a more continuous income, 76 per cent of the woodland is made up of forest stands that are intolerant of shade and root competition and that do not thrive under uneven-aged management. If such woodlots are large enough, an even-aged form of woodlot management is indicated, such as patch clear-cutting or strip cutting, particularly in cedar and poplar stands.


PART of
GANARASKA REGION
showing
RECOMMENDED AUTHORITY FOREST
and
FOREST COVER TYPES
LEGEND
RECOMMENDED AUTHORITY FOREST
FOREST COVER TYPE
SCRUB LAND WET SCRUB DRY SCRUB
PLANTATION
ORONO NURSERY
S C A L E M I L E S
0 1 2 3 4 5
CONSERVATION AUTHORITIES BRANCH, Dep't E & R M, C S V 1964
MANVERS
DARLINGTON
CLARKE
ORONO
NEWCASTLE
HOPE
PORT HOPE
HWY 35
HWY 2
HWY 401
CPR
CNR
LAKE ONTARIO

However, if woodlots are small it is advisable for the property owner to be more carefully selective in his management so as not to lose the sheltering effect of his trees.

Regeneration is fair (59.8 per cent) to poor (31.7 per cent) in the area's woodlands. This can be attributed partly to the amount of intolerant tree species present and partly to the effect of woodlot grazing. This detrimental form of husbandry has seriously affected the regeneration on 52.8 per cent of the existing woodlots in the area. Fencing cattle out of woodlots is the simplest means of solving this problem. Unfortunately this method represents a large local problem for the Authority, since 90.7 per cent of these woodlots are unfenced.

About 39 per cent of the woodland has the desired degree of stocking, and 5.4 per cent is overstocked, requiring thinning for improved stand growth. Planting or special protective measures should be performed on the 11.6 per cent of the area's woodland that is sparsely stocked. The remaining 44.1 per cent requires only a small amount of treatment to bring these woodlots up to the desired stocking level.

6. Scrublands

The invasion of open fields by scrub species, trees that never attain commercial size, such as hawthorn and sumac on dry sites and scrub willow and dogwood on poorly drained sites, is not a particular problem in this section of the Authority.

There are some individual properties in Clarke Township, where all of the area's 74 acres of dry scrub and 147 acres of wet scrub occur, that should receive some attention on the part of their owners.

Where dry scrub cover occurs, the property owner can usually make his land more productive through reforestation or, if the soil is suitable, by eradicating the scrub cover in favour of agriculture.

It is sometimes economically feasible to return wet scrubland to agriculture through drainage. If this is not possible, wet scrubland can be rehabilitated by converting it to timber production, using such species as white spruce. Such land is also often a suitable site for farm ponds.

CHAPTER 2

FOREST CONSERVATION MEASURES IN PROGRESS

There has been some private reforestation activity in this part of the Authority in the last 35 years. This reforestation covers 965 acres, of which 695 acres were planted within the last 10 years. Just over 90 per cent of this recent reforestation is being devoted to the growing of Scotch pine for Christmas trees.

Of the remaining acreages involving all plantations over 10 years of age, 36 per cent contain Scotch pine in pure stands or in mixtures with other coniferous species such as white pine, red pine, Jack pine, white spruce and European larch.

It is estimated that of the acreage planted to trees in the area examined, 330 acres were planted with timber production as the eventual aim. Only 56 acres have received any noticeable care.

Typically, the need for proper pruning and thinning is the greatest maintenance problem in this part of the Authority at the present time. Without proper treatment of the existing plantations, the final product will be timber of poorer quality. Without care, reforestation can be a doubtful investment and property owners should be aware that if good quality timber is the basic aim, a reasonable amount of care is necessary for profitable development.

Like any other crop, trees need attention through their various stages of growth. The methods of maintenance include regular periods of pruning, systematic thinning, treatment for insect or disease outbreaks, the replenishment of killed areas or areas of poor tree development and periodic inspection to determine the maintenance steps necessary.

With the exception of Manvers Township and the upper part of Clarke Township, where the growth of Christmas trees has been concentrated, the average tree plantation on this section of the Ganaraska Region is small. There are many plantations ranging from five to eight acres in area. Of the 74 plantations found during the survey, 34, or almost half, are four acres and under in size. These small plantations are rarely in a strategic position on the individual properties they occupy. In a very few cases, trees have been planted to prevent the blowing of sand off knolls, but the use of the small plantation as a shelter, windbreak or erosion control has been generally neglected by local property owners.

CHAPTER 3

FOREST CONSERVATION MEASURES REQUIRED

The activities through which the Authority may further forest conservation fall into three broad categories. In woodlot improvement demonstrations or private planting the Authority may co-operate with private landowners. In larger areas needing reforestation or management the Authority may acquire land and manage it directly. Through public meetings, field days and publications the Authority may educate and encourage residents of the Ganaraska Region Conservation Authority to practise conservation on their own lands.

1. The Ganaraska Region Authority Forest

All of the recommended Authority Forest in the first Ganaraska Report was located in the upper section of the watershed on the ridge of the interlobate moraine and the South Slope section immediately adjoining the moraine. At present over 8,000 acres of Authority Forest are under agreement with the Department of Lands and Forests and are operated jointly with the adjoining Durham County Forest. Practically all of the suitable planting sites on the present Ganaraska Authority Forest are now fully stocked to desirable tree species.

In the western section of the Ganaraska region, only a small portion of the recommended Authority Forest is located on the interlobate moraine ridge. One large block of morainic land is occupied by Mosport Race Track. The management of this track has already consulted the Conservation Authorities Branch on the best methods of erosion control on this area, which in this case must essentially be specialized.

The bulk of the recommended Authority Forest in this part of the Authority is to be found on the South Slope and Lake Iroquois plains sections. Rather than occupying one large block, this recommendation covers a series of smaller blocks, although the blocks are nearly all interconnected.

These properties may be described in three main groups.

(a) Wilmot Creek

This is an area of 1,270 acres located in the headwaters of Wilmot Creek north of Orono. The soils in the area recommended are mainly Darlington sandy loam and Pontypool sand.

It is recommended for purchase as an Authority Forest for erosion control, and for timber production on suitable sandy morainic land.

(b) Clarke Township

About 6,885 acres of land in the central and south-eastern regions of Clarke Township have been recommended for incorporation into an Authority Forest. The area recommended consists of a series of mainly interlocking properties exhibiting a variety of problems.

In the upper reaches of Graham Creek east of Orono, erosion control is a prime necessity on about 900 acres, although some swamp is also present. The soils in this section vary from steep-phase Otonabee loam to Darlington sandy loam, Bondhead loam and Granby sandy loam.

Steep valley sides exhibiting a high potential for erosion are also found along the main valley of Graham Creek.

In the south-eastern region of the township, the problem is mainly one of poor drainage and bouldery soils on lands having a low agricultural capability. These soils should be kept under permanent forest cover.

(c) Hope Township

Most of the remaining areas recommended for purchase for Authority Forest purposes consist of interconnected properties controlling the headwaters sections of two tributaries of Graham Creek and the headwaters of Marsh's Creek. Also involved are the headwaters of three small creeks that flow from the vicinity of Highway No. 2 to Lake Ontario. The land in question here exhibits a low agricultural capability and has a tendency toward sheet erosion. The total acreage recommended in Hope Township is 1,465 acres.

2. Private Planting and Erosion Control

There is a well defined network of small streams in this region with steeply sloped little valleys adjoining them. There is often very little wooded cover on these valley slopes and there is a great need for reforesting a number of long open stretches along these streams, particularly in the case of steep slopes that are now eroding. Unless this is done through such means as a strong private lands reforestation program on the part of the Authority, these valley sides will contribute considerably to further erosion and stream sedimentation.

In a rolling countryside such as that found on this part of the Authority, where most of the land is cleared (86 per cent) and where the existing forest cover is mainly in low-lying areas, the exposure of fields to adverse wind effects can be great. This exposure can be increasingly severe due to the channelling of wind by such topography.


PART OF
GANARASKA REGION
showing
SMALL AREAS
REQUIRING EROSION CONTROL
LEGEND
RECOMMENDED AUTHORITY FOREST
RECOMMENDED CONTROL METHODS
FENCING ONLY
USE OF VEGETATIVE MATERIALS
SCALE MILES
0 1 2 3
CONSERVATION AUTHORITIES BRANCH, Dept. E. & R.M., ONT. 1964
MANVERS
DARLINGTON
CLARKE
HOPE
ORONO
NEWTONVILLE
NEWCASTLE
PORT HOPE
LAKE ONTARIO
Wilmot Cr.
Mulligan Cr.
Orono Cr.
Hunter Cr.
Stetser Cr.
Foster Cr.
Graham Cr.
Bibby Cr.
Marsh's Cr.
Powers Cr.
C.N.R. (Abandoned)
C.P.R.
C.N.R.
B.F.
HWY No. 35
HWY No. 2
HWY No. 401
Abandoned Rly.

This indicates the importance of the strategic position of shelterbelts of trees, particularly on farms where this is the prime use of either natural woodlots or reforestation.

Since the planting of small reforestation plots is frequently a 4-H Forestry Club project for individual members, the co-ordination of this activity by the Authority into a comprehensive program of shelterbelt planting or stream valley erosion control planting would be a practical means to promote action on this problem.

The Authority should encourage private reforestation, particularly in these critical areas, by the provision of a tree planting service and subsidies for private planting.

WILDLIFE

CHAPTER 1

INTRODUCTION

The scope of this survey was limited to three aspects of conservation in which Conservation Authorities should influence public thinking and action concerning fish and wildlife. These aspects are as follows:

(1) Certain conditions which affect the productivity of game fish in the many streams in the region.

(2) The trend towards posting of streams in the region against trespass or fishing by the public.

(3) Possible improvement of the conditions for wildlife on farms.

The foregoing aspects, of course, do not by any means include all of the aspects of fish and wildlife management. The Fish and Wildlife Branch of the Department of Lands and Forests carries out the management of the fish and wildlife resources of the Province, and the Research Branch of that Department is constantly uncovering new factors on which the management of fish and wildlife can be based.

The abundance of wildlife is partly controlled by conditions of the soil, climate and vegetation and the availability of water which, taken together, may be classed as the habitat or living quarters of the species. Competition, disease, predators and man's activities are the additional factors which affect the numbers of wildlife.

The area encompassed by the Ganaraska Region Conservation Authority, as enlarged in 1962, occupies 229 square miles, and now includes Wilmot Creek, Graham Creek and the other small streams flowing into Lake Ontario between Wilmot Creek and Port Hope.

There is already a general account of the former and present species of wildlife in the Ganaraska Watershed in the original Ganaraska Report. However, the areas suitable for different species of fish are not defined in any detail in that report. It is the primary purpose of this report to cover the area in greater detail with regard to fish and to include the large additional area added since the Ganaraska Authority area was enlarged in 1962.

The drainage basins are characteristic ones for this part of Southern Ontario, in that the belt of high lands in the northern section is composed almost entirely of Pontypool sand and Bridgman sand of the interlobate moraine. Most of the streams originate either in these sands or in the sandy loam soils (chiefly Dundonald sandy loam and Bondhead fine sandy loam), which lie immediately to the

south of them. There appear to be adequate amounts of coarse sand and fine gravel in the stream beds to allow excellent spawning facilities for trout in the upper reaches of the streams. The middle sections of the streams pass through a till plain between many long oval hills (drumlins) east of Orono and in the neighbourhood of Elizabethville. Lower down, the streams pass through the sand plain which represents the shore of the former Lake Iroquois. The lowest courses of the streams flow over clay plains, varying in width from two to eight miles. These were once the bed of Lake Iroquois. There is, of course, a considerably milder climate along the edge of Lake Ontario than on the high hills at the headwaters of the streams. There is thus a great variety of soils, physiographic conditions and vegetation within the Ganaraska Region.

CHAPTER 2

STREAM SURVEYS

1. Environmental Conditions for Certain Species of Fish

Since one of the major purposes of this report is to map the present distribution of fish, particularly the brook trout, some mention must be made of the conditions required for the existence of this species. Two of the physical and chemical factors - temperature and oxygen relationships - have received much attention and probably are the most decisive in determining the success of the species in streams*. Hydro-genion concentration, measured as pH, and carbon dioxide levels have also been closely examined, but it does not appear that the variations in these factors in the Ganaraska Region are sufficient to bring either factor close to the lethal limit for brook trout. Brook trout tolerate a wide range of pH, from pH 4.1 to pH 8.5.

It is generally considered that small streams usually produce only small trout. The following statement was made in the original Ganaraska report, in this connection.

> 'It is stated by residents of the district that native trout were, by 1880, gone from the southern waters of the rivers and were, by 1890, very scarce in the northern reaches. It is generally accepted that, with the shrinkage of the streams themselves, trout become restricted to fewer and fewer areas and the sizes to which they grow smaller and smaller. J. R. Dymond states: "Since the size of the trout depends on the amount of food available, which is to some extent a function of the size of the stream, the shrinkage of streams brought about a decrease both in the numbers and in sizes of the trout."'

So far as oxygen is concerned, there does not appear to be sufficient pollution in those parts of the streams cool enough for brook trout to allow the oxygen relationship problem to be a significant factor in the region. We are, therefore, left with temperature and size of streams as the controlling factors in this area.

It has already been well established by testing fish in the laboratory that the best temperature range for activity and growth of brook trout lies between 55° and 66° F. (13° - 18° C.). It has also been demonstrated in the laboratory that the lethal temperature varies according to the temperature at which the fish have been "acclimated" or left for some time, but this "acclimation" temperature is never found to be constant in streams, all of which vary diurnally. It has, therefore,

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* Fry, F.E.J. Some Environmental Relations of the Speckled Trout (Salvelinus fontinalis). Proceedings of the N.E. Atlantic Fisheries Conference, May, 1951.

been decided arbitrarily that streams in which the temperature does not rise above 75° F., or those in which insects are found which are not normally present in streams having temperatures above 75° F., may be considered as suitable for brook trout.

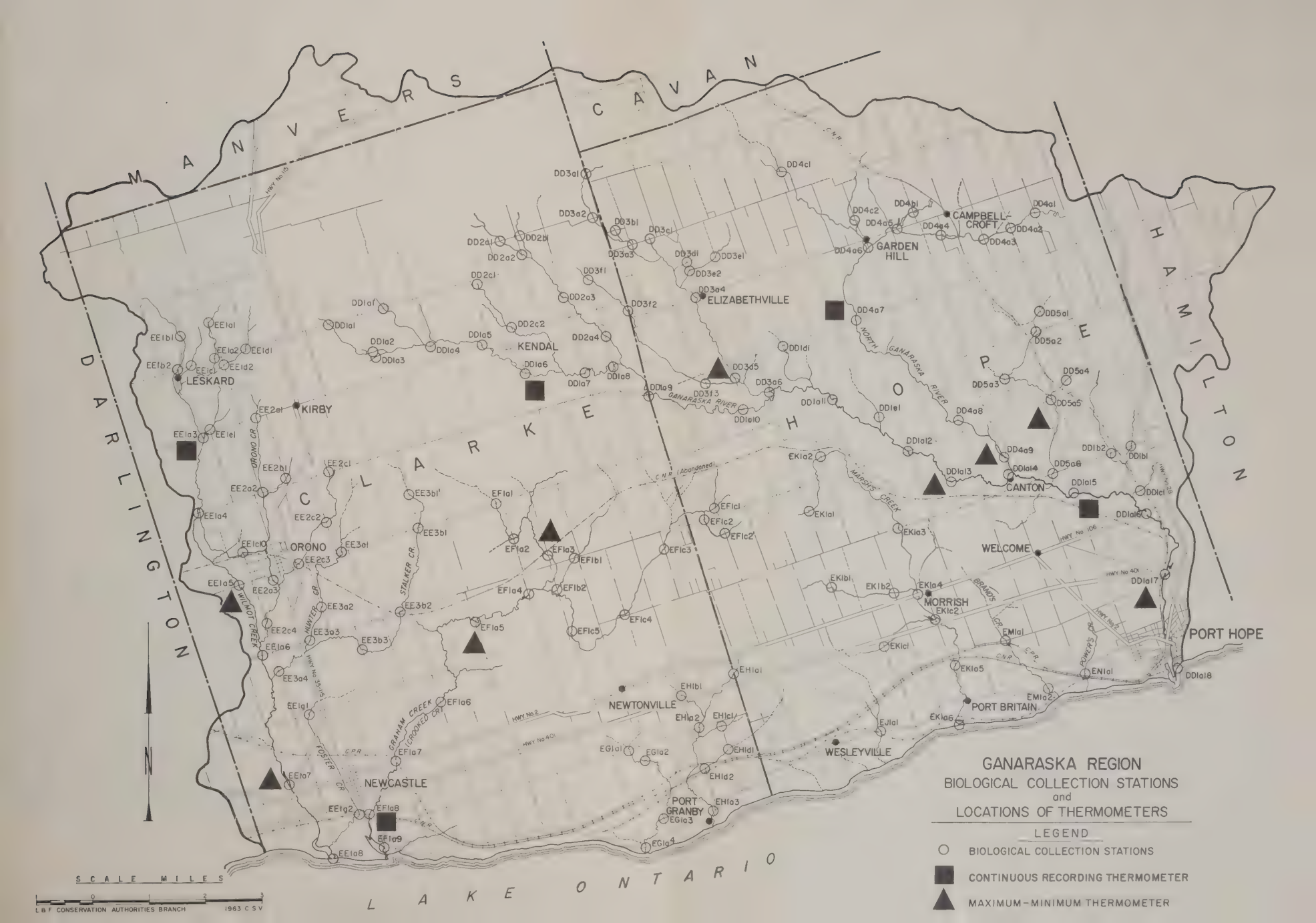
The preferred stream conditions for rainbow trout and brown trout are very similar to those for brook trout. The lethal temperature limits also all lie within 1° or 2° F. as experimentally determined. Although the lethal limits for the three species are almost identical, both brown trout and rainbow trout will still thrive in temperatures 2 or 3 degrees (Fahrenheit) higher than those preferred by brook trout. In addition, since the rainbow trout, with very few exceptions, (as, for example, in the Pine River in the Nottawasaga valley) is a migratory species, it is found in the fall, winter and spring in sections of streams which in the summer would prove much too warm for resident brook trout.

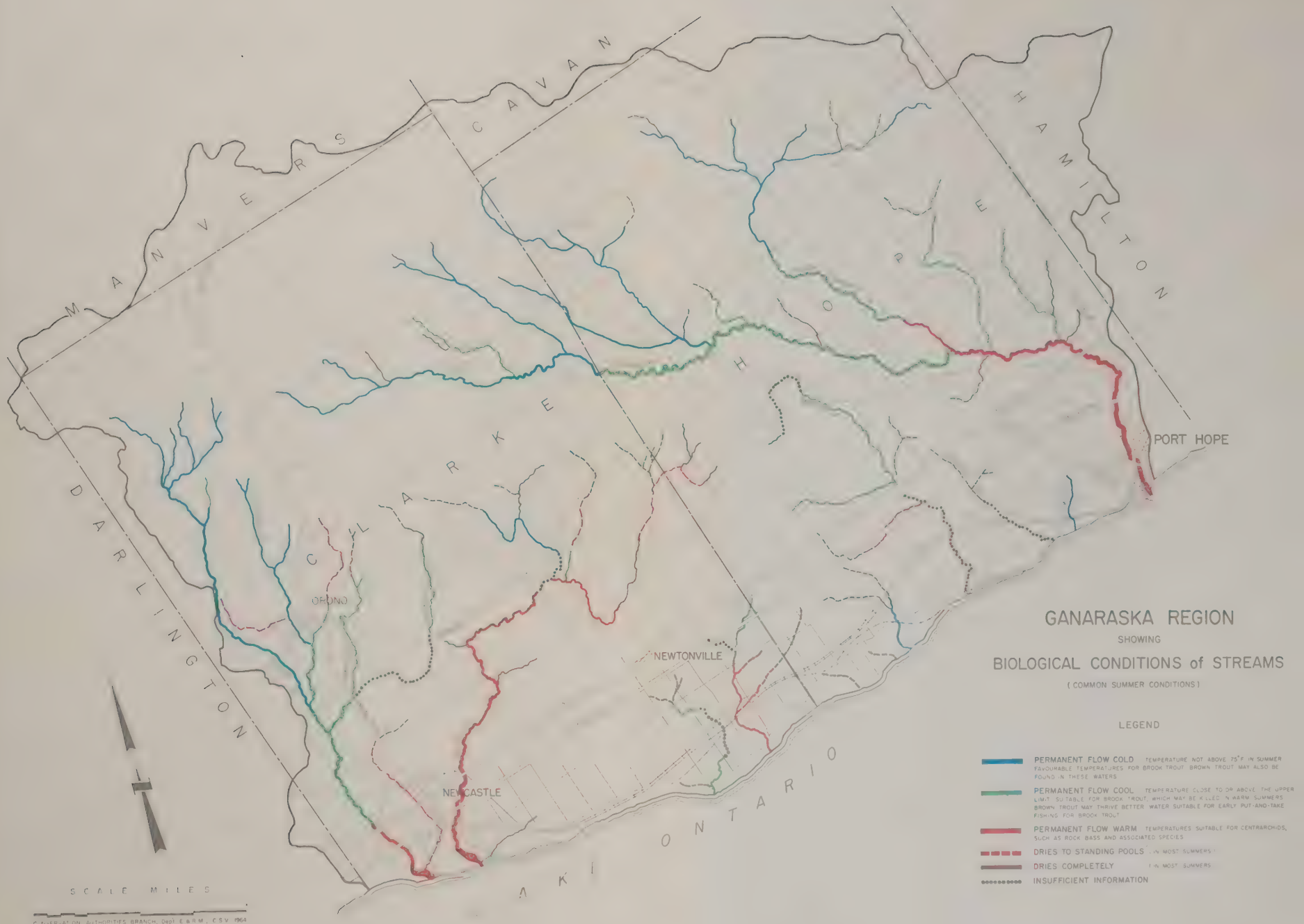
2. Methods of Survey

The procedure here adopted followed closely that used in most of the previous surveys made by the Conservation Authorities Branch in other river systems. The rivers and their tributaries were examined at "stations" from half a mile to three or four miles apart on each stream course. The erosion, vegetation, volume of flow, turbidity, temperature and type of bottom were listed for each station. At all suitable stations collections of aquatic insects and other invertebrates were made, and at most stations collections of fish were also made.

The collections were classified and used in zoning the various sections of the river. The nymphs of certain species of insects are confined to waters which remain cold and usually clear in summer, such as brook trout waters. Certain species of the genus Baetis of the mayflies are the most useful for this purpose. Other species of various genera are indicators of permanent flow or of polluted water or of high maximum summer water temperatures. The fish collections and records of eight maximum-minimum thermometers and of four continuous recording thermometers added to these findings. The maximum-minimum thermometers were installed at nine stations and the recording thermometers at five stations and both types were left in place for several weeks, and were examined once or twice a week.

The present criteria were developed from more intensive year-round research carried out by Dr. F. P. Ide of the Department of Zoology, University of


MANVERS
CAVAN
HAMILTON
DARLINGTON
CLARKE
HOPE
LAKE ONTARIO
LESKARD
KIRBY
KENDAL
ELIZABETHVILLE
GARDEN HILL
CAMPBELL-CROFT
CANTON
WELCOME
MORRISH
PORT HOPE
ORONO
NEWCASTLE
NEWTONVILLE
PORT BRITAIN
WESLEYVILLE
PORT GRANBY
NORTH GANARASKA RIVER
GANARASKA RIVER
ORONO CR
WILMOT CREEK
HUNTER CR
STALKER CR
FOSTER CR
GRAHAM CREEK (CROOKED CR)
MARSH'S CREEK
BROWN'S
POWERS CR
C.N.R.
C.P.R.
HWY No 15
HWY No 2
HWY No 401
HWY No 35/115
HWY No 28
HWY No 106
HWY No 401
N
SCALE MILES
0 3 6
L & F CONSERVATION AUTHORITIES BRANCH 1963 C S V
GANARASKA REGION
BIOLOGICAL COLLECTION STATIONS
and
LOCATIONS OF THERMOMETERS
LEGEND
BIOLOGICAL COLLECTION STATIONS
CONTINUOUS RECORDING THERMOMETER
MAXIMUM-MINIMUM THERMOMETER


MANVERS
CAVAN
HAMILTON
DARLINGTON
CLARKE
HOPE
ONTARIO
PORT HOPE
ORONO
NEWTONVILLE
NEWCASTLE
GANARASKA REGION
SHOWING
BIOLOGICAL CONDITIONS of STREAMS
(COMMON SUMMER CONDITIONS)
LEGEND
PERMANENT FLOW COLD TEMPERATURE NOT ABOVE 75°F IN SUMMER FAVOURABLE TEMPERATURES FOR BROOK TROUT BROWN TROUT MAY ALSO BE FOUND IN THESE WATERS
PERMANENT FLOW COOL TEMPERATURE CLOSE TO OR ABOVE THE UPPER LIMIT SUITABLE FOR BROOK TROUT WHICH MAY BE KILLED IN WARM SUMMERS BROWN TROUT MAY THRIVE BETTER WATER SUITABLE FOR EARLY PUT-AND-TAKE FISHING FOR BROOK TROUT
PERMANENT FLOW WARM TEMPERATURES SUITABLE FOR CENTRARCHIDS, SUCH AS ROCK BASS AND ASSOCIATED SPECIES
DRIES TO STANDING POOLS IN MOST SUMMERS
DRIES COMPLETELY IN MOST SUMMERS
INSUFFICIENT INFORMATION
SCALE MILES
CONSERVATION AUTHORITIES BRANCH, Dept E & R M., C S V 1964

Toronto.* The analysis by J. B. Hallam† of previous river surveys by this Branch was also useful.

3. Stream Conditions

The streams were examined between August 1 and September 10, 1963, many of them only once. It was therefore necessary to rely partly on deductions made from the presence or absence of species known to be reliable indicators.

The permanence of flow of the main rivers and streams and an indication of the summer water temperatures as they affect the distribution of fish are shown on the accompanying map "Biological Conditions of Streams". The greatest daily fluctuations in temperature are found in sections coloured green. Brook trout may inhabit some of the green sections, but will either move to cooler sections or be killed in periods of hot weather. The areas coloured red, if they have good volume of flow, may contain largemouth or smallmouth bass, or pike, and will almost invariably contain numbers of suckers and many small species which are important as forage fish but of little other importance.

Unfortunately, the weather during the period of examination included no period of prolonged high temperatures and this situation made the use of thermometers of less value than usual. At several stations indicator species of insects were not found. These two conditions made the classification of streams much more difficult than is usual.

The more significant stream sections which were difficult to classify are here discussed. In the following comments the individual collection stations, as shown on the accompanying map, "Biological Collection Stations" are used as reference points.

Intermittent rains during the latter part of the survey made it impossible to classify part of Stalker Creek, a tributary of Wilmot Creek (Stations EE3b2 and EE3b3). It is possible that this is a warm stream under average summer conditions, but the stream contained nymphs of a mayfly Baetis rusticans which is not normally found in warm streams, and a species of fish, Cottus bairdi, one of the sculpins, which are normally found in cool or cold streams.

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* Ide, F.P. The Effect of Temperature on the Distribution of the Mayfly Fauna of a Stream: University of Toronto Studies, Biology 39, Ontario Fisheries Research Laboratory Publication 50, 1935.
Ide, F.P. Quantitative Determination of the Insect Fauna of Rapid Water. University of Toronto Studies Biology 47, Ontario Fisheries Research Laboratory Publication 59, 1940.

† Hallam, J.B. Habitat and Associated Fauna of Selected Species of Fish in Ontario Streams, M.A. Thesis, University of Toronto, 1954.

No stream temperatures could be gauged on Foster Creek which runs along the westerly edge of Newcastle, (Stations EE1g1 and EE1g2) but it appeared from local information that the stream dries to standing pools in summer. Another mayfly usually found in cool streams, (Baetis brunneicolor), was found in Orono Creek (Stations EE2a2 and EE2a3), but other indicators suggested that the stream may be intermediate in temperature.

The most northerly tributary of Orono Creek (Station EE2b1) had almost no flow, but was reported by a resident to have brook trout in it, and it has therefore been classified as a cold permanent stream. None of the usual reliable insect indicators were found in this stream.

The first tributary of the Ganaraska River east of Canton (Stations DD5a1 to DD5a8) had temperatures ranging from 42° F. to 75.5° F. and is therefore classed as an intermediate stream marginal for trout. However the mayfly Baetis vagans, usually an excellent indicator of trout water, was present in it. This may well support trout in all but the warmest summers.

The point at which the Ganaraska River crosses the Town Line between Clarke and Hope Townships (Station DD1a9) appeared to be marginal for brook trout.

The northern extremity of Graham Creek, otherwise known as Crooked Creek, in Clarke Township, (Stations EF1a2 and EF1a3) appeared to be of intermediate temperature but local farmers reported that there are brook trout in it and it has therefore been classified as a permanent cold stream.

With these possible exceptions, the accompanying map "Biological Conditions of Streams" may be considered as giving an accurate picture of the common summer conditions in the Ganaraska River, Wilmot Creek and the streams lying between them.

CHAPTER 3

FISH DISTRIBUTION

1. Former Conditions

The name Ganaraska is derived from the Iroquois name "Ganaraské" which meant "the spawning place", referring to the former abundance of landlocked salmon in the river. Some idea of the quantities of salmon in the Ganaraska about 1800 is given by the following quotation from the original Ganaraska Report: "In 1801, James Sculthorpe, together with an uncle, speared 300 salmon in one evening". The salmon were apparently declining in numbers by 1850. The decline became even more marked between 1860 and 1880. The last date given for the occurrence of salmon in Lake Ontario is about 1895. The major factor which caused the disappearance of salmon from Lake Ontario is not known. The chief causes are considered to be the presence of high dams on the rivers, the silting of the inshore waters of the lake, the destruction of spawning beds by the great quantities of sawdust and bark, and the intensive commercial fishing by nets and spears.

No history of the landlocked salmon in the Ganaraska and in Wilmot Creek would be complete without some mention of the Wilmot Creek hatchery. The name of Wilmot Creek is taken from Samuel Wilmot through whose property the creek flowed. In the early 1860's Samuel Wilmot succeeded in fertilizing salmon eggs with milt taken from the males. This highly successful operation resulted in a hatch of about 15,000 salmon fry in 1867, and the Government of Canada then financed the work. The whole history of Samuel Wilmot's spectacular efforts to increase the yield of young fish is very adequately summarized by H.R. McCrimmon* in a recent publication. Although the production of breeding salmon was later a total failure, "in 1868 a full scale fish culture operation was launched which over the next 50 years was to produce 155,000,000 fish of a variety of species".* A practical system of fish culture was here developed which, with some improvements, has been a model for fish propagation in a great many countries.

While the salmon undoubtedly was a very important article of food for the early settlers, the sturgeon was also a valuable fish, and certainly used the Ganaraska and probably Wilmot Creek in its spawning activities. It was at first not

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* McCrimmon, H.R., "The Beginnings of Salmon Culture in Canada", Canadian Geographical Journal, September 1965.

recognized as an edible species and was disliked because it destroyed nets. Many sturgeon weighing more than 200 pounds have been taken from the Great Lakes and one caught in Lake of the Woods was 152 years old.* The flesh is now considered very valuable as is, of course, the roe which provides caviar. It is unlikely that any sturgeon use the rivers of the Ganaraska Region now.

2. Present Fish Distribution

The following 20 species of fish were found in the rivers and streams of the Ganaraska Region during the survey. Species of particular interest to anglers are starred:

Fish Species	No. of Stations where collected
Salmonidae - salmons and trouts	
* rainbow trout	9
* brown trout	6
* brook trout	20
Catostomidae - suckers	
* white sucker	38
Cyprinidae - minnows	
hornyhead chub	1
common shiner	22
blacknose dace	55
northern redbelly dace	9
bluntnose minnow	21
blacknose shiner	2
* creek chub	44
fathead minnow	5
longnose dace	21
Centrarchidae - sunfishes	
* rock bass	6
* small mouth bass	2
Percidae - perches	
Johnny darter	24
rainbow darter	9
Cottidae - sculpins	
mottled sculpin	12
slimy sculpin	12
Gasterosteidae - sticklebacks	
brook stickleback	10

The names and order in the above list follow those of "A List of Ontario Fishes" by W.B. Scott and E.G. Crossman, Royal Ontario Museum publication, 1961.

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* MacKay, H.H., "Fishes of Ontario", Department of Lands and Forests, Ontario 1963.

The distribution of eight of the species of fish, as determined from the 1963 collections, is shown on the accompanying map "Fish Distribution". The Garden Hill pond was not examined as it is regularly stocked with brook trout, and from all reports the species appears to thrive in it. Smallmouth bass were found at only two stations, both on Graham (Crooked) Creek, but they probably are to be found in the narrow bays at the mouths of Wilmot and Graham Creeks. The distribution of the two species of sculpins is also shown on the map, because both species, but particularly the slimy sculpin (Cottus cognatus), are often found in association with brook trout. It should be added, however, that the mottled sculpin (Cottus bairdi) is sometimes found near the mouths of streams into which the species migrates from cool lake waters.

There are, of course, other species of fish in the rivers. Carp, which are extremely elusive and are frequently missed in minnow seine collections, frequent the mouths of the rivers and no doubt occur in warmer sections of other parts of the river. The American smelt also ascends the streams of the region in spring for spawning purposes and is extremely common in late April. This species, which originally came into rivers annually from salt water, now occurs in all of the Great Lakes, probably as a result of introductions begun in Crystal Lake, Michigan, in 1912.

Brown trout were stocked originally in the Ganaraska River in 1933 and 1934. Recent stockings of brook trout and brown trout are shown in the list on the following page.* There have, of course, been other stockings in ponds.

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* Data supplied by the Department of Lands and Forests, Lindsay District Office.

LIST OF FISH PLANTED IN THE GANARASKA RIVER AND TRIBUTARIES AND IN WILMOT CREEK IN RECENT YEARS

(yr. = yearlings fg. = fingerlings)

WILMOT CREEK

1955	brown trout	3000 yr.	Lot 31, Con. 4, Clarke Twp.
		2000 fg.	Lot 23-33, Con. 5-7, Clarke Twp.
1956	brook trout	1000 yr.	
	brown trout	1000 yr.	
1957	brown trout	2000 yr.	
1961	brook trout	800 yr.	

GANARASKA RIVER

1955	brook trout	1000 yr.	Lot 28, Con. 6, Hope Twp.
		1000 yr.	Lot 8, Con. 5, Hope Twp.
		500 yr.	Lot 9, Con. 7, Hope Twp.
		500 yr.	Hope Twp.
	brown trout	1500 yr.	Feeder Streams
1956	brook trout	1000 yr.	Lot 17, Con. 7, Hope Twp.
	brown trout	3500 yr.	In the Feeder Streams
1957	brook trout	2000 yr.	
	brown trout	2500 yr.	
1958	brown trout	4000 yr.	
1959	brown trout	4000 yr.	
1960	brook trout	900 yr.	
1961	brook trout	1000 yr.	
1962	brook trout	750 yr.	
1963	brook trout	750 yr.	
1964	brook trout	500 yr.	

GARDEN HILL POND

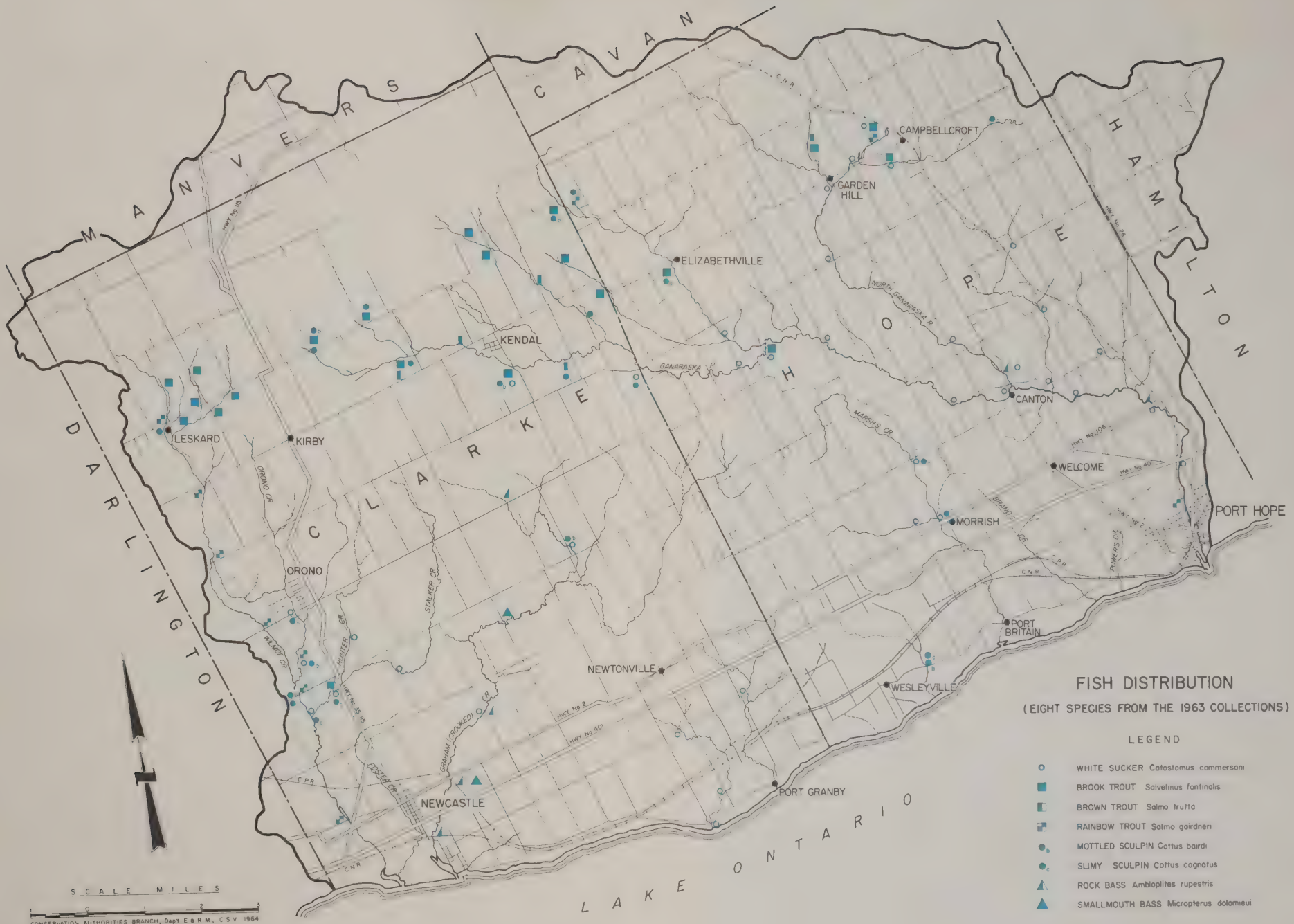
Lot 18, Con. 8, Hope Township

1961	brook trout	2500 yr.
1962	brook trout	2000 yr.
1963	brook trout	3663 yr.
1964	brook trout	2064 yr.

The brown trout occurred in only six collections during the survey. Only a few brown trout have been reported to have been taken by angling in the rivers (as distinct from ponds). In explaining this fact, J. R. Dymond, as quoted in the original Ganaraska report, states:

> "Where brown trout have access to large bodies of water, they frequently leave the streams in which they are planted. At least three brown trout have been taken in fishermen's nets in Lake Ontario".

However, it was reported by the late Ario Gatti who took many underwater photographs of fish in Wilmot Creek, and confirmed these findings with his photographs, that there was a good population of brown trout in Wilmot Creek in 1965.


MANVERS
CAVAN
HAMILTON
DARLINGTON
CLARKE
HOPE
LAKE ONTARIO
CAMPBELLCROFT
GARDEN HILL
ELIZABETHVILLE
KENDAL
LESKARD
KIRBY
ORONO
CANTON
WELCOME
MORRISH
PORT HOPE
PORT BRITAIN
WESLEYVILLE
NEWTONVILLE
NEWCASTLE
PORT GRANBY
NORTH GANARASKA R.
GANARASKA R.
MARSH'S CR.
BRANDY CR.
POWER'S CR.
ORONO CR.
STALKER CR.
HUNTER CR.
WEMOT CR.
FOSTER CR.
GRAHAM (CROOKED) CR.
HWY No 115
HWY No 2
HWY No 401
HWY No 106
HWY No 40
HWY No 28
C.N.R.
C.P.R.
SCALE MILES
0 1 2 3
CONSERVATION AUTHORITIES BRANCH, Dept E & R M., C S V 1964
FISH DISTRIBUTION
(EIGHT SPECIES FROM THE 1963 COLLECTIONS)
LEGEND
WHITE SUCKER Catostomus commersoni
BROOK TROUT Salvelinus fontinalis
BROWN TROUT Salmo trutta
RAINBOW TROUT Salmo gairdneri
MOTTLED SCULPIN Cottus bairdi
SLIMY SCULPIN Cottus cognatus
ROCK BASS Ambloplites rupestris
SMALLMOUTH BASS Micropterus dolomieui

The Garden Hill Pond deserves special mention, as it is a Conservation Authority project. From various reports, and particularly that of the Conservation Authority's Field Officer, it appears that the chief species caught in the pond is brown trout, although the species planted is brook trout. To increase the catch in the pond, it might be advisable to have it stocked with brown trout and, if necessary, with a forage fish as well. The existing brown trout may well be consuming the yearling brook trout planted in the pond annually.

Rainbow trout were first introduced into the Great Lakes drainage system in 1895. The Ontario Department of Game and Fisheries began a widespread stocking of the species in 1918. Relatively recently they have been using the Lake Ontario and Lake Erie tributary streams. The species is common in Wilmot Creek and in the spring the fish ascend the Ganaraska to a point a few miles north of Port Hope where they are commonly blocked from travelling further upstream by the remains of a former dam at Station DD1al6. Residents of Port Hope approve of this blockage because it results in easy fishing at a single point. Residents farther up the stream do not concur. However, a few small rainbow trout were caught during the survey in the north branch of the Ganaraska River near Campbellcroft and in a tributary of the main branch northwest of Elizabethville, indicating they must occasionally find their way over the above-mentioned obstruction, unless they have been introduced in the upper reaches, which appears unlikely. The other species of fish in the list, apart from the white sucker, creek chub and rock bass, are all small species which are of little interest to the angler and are merely forage fish for the larger species.

The Authority might well urge the limiting of trout stocking to those waters which are shown in this survey to be suitable for trout and which can be proved to have present populations below the carrying capacity of the stream. An exception might be made for waters used for early put-and-take fishing.

CHAPTER 4

POLLUTION EFFECTS ON FISH

At the time of the survey there was very serious pollution of the Ganaraska River at Port Hope, which probably affected fish survival. The chief sources were occasional dumping from a chemical company and almost continuous dumping from a leather processing plant. The leather processing plant has since been removed to a new location from which the effluent is now adequately treated.

Two field surveys of pollution on the Ganaraska River and in the Town of Port Hope were conducted by the Ontario Water Resources Commission late in 1964. Sixteen points on the river above Port Hope were examined for 5 day B.O.D.,* for total, suspended and dissolved solids, and for total coliforms per millilitre. The flow during the sampling period was "approximately minimal" which makes the results very useful.

The conditions in the river and tributaries above Port Hope were found to be exceptionally good. Occasional cattle pollution was found by the Conservation Authorities Branch field crew, but nothing of any serious nature. With one exception, the B.O.D. was well below the Ontario Water Resources Commission's objective of 4 parts per million. A B.O.D. value in excess of the Commission's objectives was noted at Port Hope in the sample collected from the ditch which discharges to the bank on the south side of Barrett Street. The Authority might well urge that this pollution be eliminated.

It should be noted, however, that random sampling of the water in a river does not always show the results of occasional dumping such as occurs from the chemical plant. A single dumping of chemicals may result in a "slug" (of compounds poisonous to fish) passing down the river.

The Ontario Water Resources Commission's report states that "commendable progress has been made in the elimination of pollution by industrial wastes" at Port Hope.

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* B.O.D. of polluted waters is the oxygen required during stabilization of the decomposable organic or chemical material by aerobic biochemical action. Decomposition for 5 days at 20 degrees Centigrade was used, and this is the accepted standard, as 80% to 90% of possible decomposition is attained in five days.

A view looking upstream to the control dam at the Garden Hill pond. The water is taken from the surface instead of from the bottom of the pond. A better method is shown on an accompanying plan.

Pollution on the Ganaraska River at Port Hope. Discarded paint is obviously thrown out of the window nearest to the camera.

The dilution is evidently great enough during the spring run of rainbow trout to allow some of these fish to pass up the river through the town, because they reach a dam above it.

However, the dumping of chemicals from the windows of the chemical company, as shown in the accompanying photograph, should, of course, be stopped permanently.

CHAPTER 5

STREAM IMPROVEMENTS FOR FISH AND ACQUISITION OF AREAS FOR PUBLIC FISHING

Studies in numerous places on this continent have already shown that the availability of suitable cover and feeding sites are the dominant factors in delimiting the standing crops of older trout (age 1 and older). Assessment of the populations before and after treatment of streams by Saunders and Smith in Canada,* and by workers in Wisconsin, Michigan and New York State using electric shockers, have left no doubt that various devices can create new habitats for both fingerlings (age 0) and older trout in what were formerly barren sections of a stream.

The number of eroded banks which may be noticed on the tributaries and the main streams of the Ganaraska River and Wilmot Creek also show the need for stream bank protection measures. Where large stones are plentiful, they can be used effectively to prevent erosion by dropping them down the bank of a stream with the aid of a front-end loader, as is done on Michigan streams. If necessary, they can be arranged in place by hand.

1. Vegetative Measures

Vegetative soil protection should play the major role along the stretches of streams near their sources. The following species of shrubs can be used:

Purple-osier Willow
Silky Dogwood
Red-osier Dogwood

These species also contribute valuable wildlife habitat for upland game and songbirds, and add aesthetically to the rural landscape. The following crop species should also be used:

Reed Canary Grass
Red Fescue
Birdsfoot Trefoil

The species most commonly used on stream banks is Reed Canary Grass. As the individual areas are small, broadcasting by hand and raking in with an ordinary garden rake are the usual practical ways of doing this work. Where grazing

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* Saunders, J.W., and Smith, M.W., Physical Alterations of Stream Habitat to Improve Trout Production. Fisheries Research Board of Canada, St. Andrews, New Brunswick, 1960.

Alternate riffles and pools make the most productive trout streams. This stream, in Hope Township, would be more effective if it were narrower and deeper.

A good deep hole on the Ganaraska River in trout water (Hope Township). Many trout have been taken from this hole.

is practised, any revegetation work will usually require complete protection. To accomplish this the fencing of the stream course and long narrow strips of bottomland has been demonstrated to be very effective. The installation of water-gaps is necessary to provide watering places for livestock. Where this is done the stream bottom should be covered with small stones or gravel. Stream-bank fences also protect the existing vegetation and may often be justified on this basis alone.

2. Structural Devices

Structural devices include small dams and deflectors. Other more complicated devices have been used elsewhere but are hardly justified in the relatively small streams of the Ganaraska River and Wilmot Creek, and are not discussed in this report.

Small dams can certainly be valuable in very shallow streams. They may be made of large rocks backed by a seal of gravel and clay, or they may be made of any available wood such as large smooth logs, old railroad ties or, better, old squared timbers from former houses or bridges. In rock dams, only large oblong rocks should be used in the main course, and they should be placed with the longest axis parallel with the direction of flow. The only points that must be stressed in log dams are that a gravel and mud seal is absolutely essential and that the logs must be well keyed into the bank. The lowest log should be placed flush with the bottom of the stream and the logs should be spiked together. Small dams have a tendency to silting above the dams. Their best effect seems, in fact, to be the pools below the dam created by the erosive action of the water which pours over them. These small dams are not illustrated in this report.

Deflectors are used for three purposes:

(1) To scour pools by constricting the channel, thus increasing the cutting power of the stream flow.

(2) To protect eroding banks.

(3) To cut off undesirable side channels.

Single-wing deflectors are commonly placed on the outside of a bend of a stream, so as to deflect water away from the point where erosion is likely to take place. An example of such a device is the single-wing deflector shown on the accompanying sketch. This provides a pool at the outer end of the logs. The method of construction can easily be seen from the illustration. Two single-wing deflectors are often placed opposite each other so as to narrow the stream and provide a deep hole.

The Conservation Authority might well improve at least one stretch of publicly owned stream as an example to private owners. A careful examination of the areas recommended as Ganaraska Forest in the original Ganaraska Report and the areas recommended as Authority Forest in the present Forestry Section for the enlarged Ganaraska Region, will show that there are several sections of trout streams which pass through these recommended areas. It is recommended that the Authority give priority to the acquisition of these areas for reforestation purposes and in so doing make an agreement with the Department of Lands and Forests for improvements on the streams, thereby carrying out two purposes on each area.

3. Construction of Trout Ponds

The most effective means of increasing trout waters in the Ganaraska Region is undoubtedly the construction of ponds on the trout streams. A few small trout ponds have been constructed already, in addition to the Garden Hill Pond.

Before constructing any dam, fish ladder or obstructing device in a stream approval of the plans must be obtained from the Surveyor-General of the Department of Lands and Forests of Ontario. Where water is to be withdrawn or the flow stopped for a time, permission must also be obtained from the Ontario Water Resources Commission, specifying the date and time at which the water will be withdrawn or the flow stopped.

The ideal pond for production of brook trout or brown trout is the cool pond with continuous inflowing water and maximum temperatures at the surface of 70 degrees to 75 degrees, and cooler bottom water. Such ponds are usually placed near the headwaters and range in size from about an acre to 8 or 10 acres. The depth should be ten feet or more in the deepest part and the sides of the pond should be steep. A spring flow of as low as half a cubic foot per second will maintain a pond of one acre quite successfully.

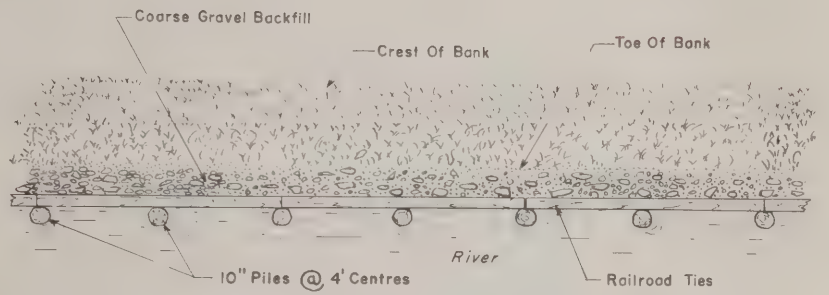
Ponds inevitably have the effect of warming the water in a stream. In a properly constructed trout pond the outlet of each dam should be a pipe (with a screened inlet at the bottom of the pond) rising close to the normal surface level and there passing through the dam, so that cold water is drained from the bottom and the warm surface water is not allowed to flow over the dam. The surface water in the pond serves as an insulating layer, and the water downstream from the pond has scarcely been heated by its passage through the pond. The pipe should be of such a size as to discharge the minimum summer flow. In time of floods, the additional

An attractive stretch of stream in the upper waters of the Ganaraska River. The water is suitable for trout so far as temperature is concerned, but large trout are of course not found in it except at spawning periods.

A poor stream improvement project on the Ganaraska. The stream is too shallow and too narrow. Deflectors, which narrow the stream and deepen it, would have been more successful.

A wasted attempt at bank erosion control with pipes wired together in the stream, on Graham (Crooked) Creek. A better method of controlling bank erosion is shown on an accompanying drawing.

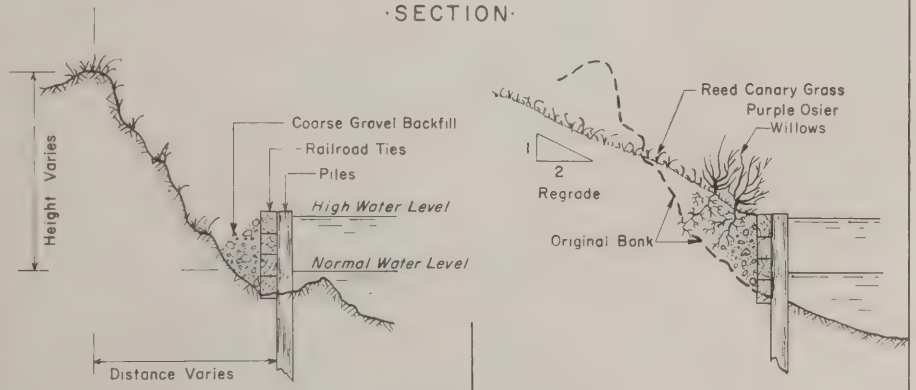
Another attempt at stream bank erosion control, at Sylvan Glen Park on the Ganaraska River. Hand placed riprap of sharp-angled limestone is more effective but much more expensive.



·PLAN·

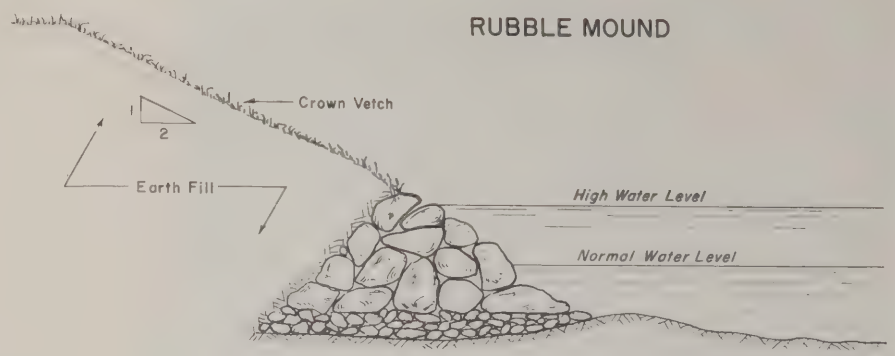
TIMBER PILE AND LAGGING

·SECTION·

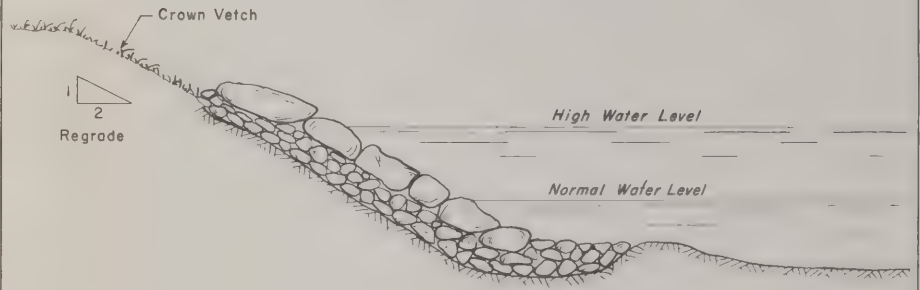


STAGE 1 STAGE 2

RUBBLE MOUND



PLACED RIP RAP



TYPICAL STREAM BANK PROTECTION MEASURES

CONSERVATION AUTHORITIES BRANCH Dept. E. & R.M. Wm.M. 1965

flow would pour over the dam at a suitable outlet or be carried around it by a grassed spillway. At such a time it is very unlikely that the temperature of the water would be above 75 degrees. A more efficient but rather more expensive method of passing the bottom water from a pond downstream is illustrated in an accompanying drawing, shown both in section and plan. Two series of stoplogs are used, and the highest stoplog is used to adjust the flow. Using this method the pond can also be drained if needed.

The by-pass type of pond has two particular advantages for the production of either brook trout or brown trout. A pond of this class is built close to, but not on, a permanent stream and gets its name from the fact that the water supply is by-passed through a pipe from the stream to the pond. The first advantage is that there is no danger of the pond filling up with silt, because any excessive runoff goes down the permanent stream channel and not through the pond. The other advantage is that, by control of the amount of cold water entering the pond, the temperature of the pond may be adjusted to give the maximum growth rate in the fish kept there.

Trout ponds do not normally have spawning beds for trout and, therefore, must be managed on a put-and-take basis, i.e., stocked artificially.

Warm water ponds are discussed in detail in the chapter "Improving the Land for Wildlife".

4. Posting of Streams

There is an alarming increase in the posting of streams against fishing in the Ganaraska Region. This results naturally from the fact that there has recently been a great increase in the number of non-resident individuals, from Toronto and Oshawa particularly, who have acquired land containing trout streams. In this preliminary survey not all of the road crossings of streams were examined. However, examinations of 66 stream stations in the waters suitable for trout showed that at 34 stations the stream was posted against trespass, while at 32 stations the stream was not posted. In other words, about half of the streams are posted against fishing by the public. It should also be noted that many of the stations which are not posted lie in the headwaters where the streams are so small that, while they may produce trout, they do not produce large trout suitable for fishing. There are now excellent reasons to expect that, unless some streams are opened to public fishing, the whole of the trout waters in the Ganaraska Region, other than those in the Ganaraska Forest, will shortly be closed to the public. This is another reason why

the Ganaraska Region Conservation Authority should give some thought to the acquisition of certain stretches of trout streams for fishing by the general public.

The legal status of the posting of streams described above is hard to define. The following excerpts are taken from Section 66 of The Game and Fisheries Act, in the Revised Statutes of Ontario, 1960:

Subsection 2

"No person shall hunt or fish or with any gun or sporting implement, fishing rod or tackle in his possession go upon any enclosed or unenclosed land or water after he has had notice not to hunt or fish thereon by the owner either by word of mouth, in writing or by posters or signboards so placed that they may be observed from any point of access to the land."

Subsection 5

"Every person found contravening subsection 2 may be apprehended without warrant by a peace officer or by the owner of the land on which the contravention takes place, or by the servant of, or any person authorized by, such owner, and be taken forthwith to the nearest Justice of the peace to be dealt with according to law."

It is also stated in the same Act that

"No person shall tear down, remove, damage, deface or interfere with any poster or signboard placed pursuant to subsection 2."

The question of what constitutes any point of access to land is obviously an important one, since legally a gate or even a fence may be considered a point of access. It appears therefore that much of the "posting" of streams in the Ganaraska Region does not comply completely with the requirements under The Game and Fisheries Act. Where it is suspected that there may be difficulty in obtaining a conviction under the above Act, recourse might be taken to the Petty Trespass Act (Revised Statutes of Ontario, 1960, Chapter 294), in which the matter of trespass is more broadly defined. However the fine imposed under this Act is a negligible one.

SINGLE-WING DEFLECTOR

CHAPTER 6

IMPROVING THE LAND FOR WILDLIFE

Landowners differ greatly in what species of wildlife they wish to have on their land. In this area the landowners also differ widely in their views on the subject of public hunting. There is a steadily increasing interest in natural history in the region. However, in the region as a whole, organized and unorganized hunters and fishermen greatly outnumber the naturalists.

A Conservation Authority stands to gain little, if anything, from producing more game and fur, but the economy of the region is thereby enriched, and the improvement of lands for wildlife should be promoted and encouraged by every Conservation Authority as a means of increasing the multiple use of its lands for as many people as possible.

The Ring-necked Pheasant, one of the most important game birds in Ontario, finds only marginal range in the Ganaraska Region*. None were observed during the survey, but the species may find suitable territory near to the lake front where the temperature is much milder than northwards in the hills.

The chief species hunted in this region are now deer, ruffed grouse, European hares, varying hares, cottontails, red foxes, raccoons and red and black (or grey) squirrels. Of these species the cottontail and the European hare undoubtedly provide the most hunting. There is a short open season on deer in Clarke Township but Hope Township is at present closed to the hunting of deer.

1. Woodlands

The elimination of over-grazing in the farm woodlots would be the most useful single measure in improving the wildlife environment. There is one exception to this statement. Light grazing of the edge of a woodlot which has a good rich and preferably damp soil may make the area very attractive to woodcock.

In young plantations on grassy land the entire planted area is valuable for wildlife. But large blocks of coniferous trees will, at least after about the twelfth year from planting, have little or no undergrowth and will, apart from edges or firebreaks in them, be relatively sterile as far as upland game and most forms of wildlife are concerned. The chief improvements to be expected will,

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* Clarke, C.H.D., and Braffette, R. Ring-necked Pheasant Investigation in Ontario, 1946. Department of Lands and Forests, Ontario, Miscellaneous Publications, 1947.

therefore, come from good management of the farm woodlot. In mixed woodlands selective cutting is both sound forestry practice and good for wildlife. Landowners who have woodlots in which the crown canopy has closed over considerable areas and who wish to produce a proper environment for wildlife, will find that release cuttings, slashings to stimulate sprout growth, thinnings and felling timber for sale will improve rather than reduce the carrying capacity for wildlife. Construction of brush piles from cuttings is recommended where cottontail rabbits are desired, two or three such brush piles per acre being the normal spacing.

2. Cultivation Practices

All good farming practices which make a more luxuriant vegetation will improve the farm environment for wildlife. A few special practices will give more specific benefits. Strip-cropping is of particular value, since by this means no extensive area is denuded of cover at one time by harvesting. Grassed waterways provide travel lanes and nesting cover for wildlife. Cover crops such as Hairy Vetch and Crown Vetch provide a habitat and food for wildlife in areas that would otherwise be barren during the winter months. A large number of the brushy fence rows in the Ganaraska watershed have been eliminated, particularly in the southern part of the watershed. Those who are interested in wildlife improvement will find that the inclusion of a few field boundary hedges on the farm will moderate the effect of winds on crops, serve as travel lanes and cover for wildlife and harbour large numbers of song birds which help to control insect pests. Inevitably the presence of boundary hedges on a farm tends to encourage the growth of weeds. This is the price that must be paid for improved wildlife conditions in farmland.

Interest in wildlife, particularly in birds, has grown very quickly in Ontario in the last twenty years. The Federation of Ontario Naturalists is now a large organization including a great many clubs and a large number of individual members who do not belong to a particular club but are much interested in natural history and conservation. The Federation, besides publishing regularly a journal, "The Ontario Naturalist", also sponsors many regional field gatherings, one of which is held every year in the Ganaraska Region. This is in an area frequented by a great many migrant birds (including many shore birds) near Port Britain, about four miles west of Port Hope.

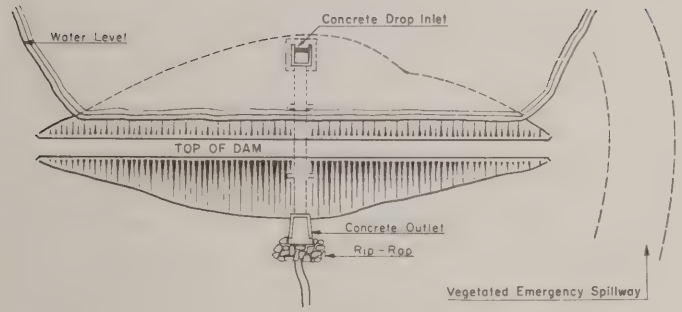
While no exact record is available for the region as a whole, it can be assumed from the records of nearby areas that at least 210 different species of birds occur at some time of each year in the Ganaraska Region, and that approximately

Part of the Garden Hill pond. This pond is stocked with trout and provides excellent fishing.

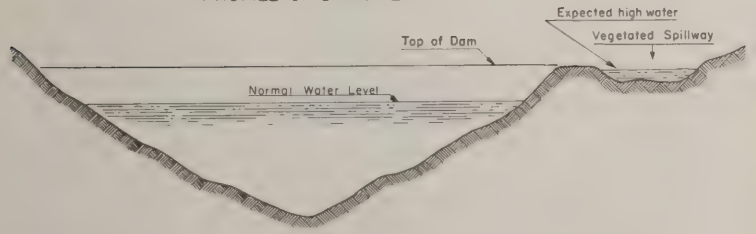
Another view of the Garden Hill pond showing extensive erosion on the property of the Ganaraska Region Conservation Authority. Such erosion should certainly be checked to prevent silting in of the pond.

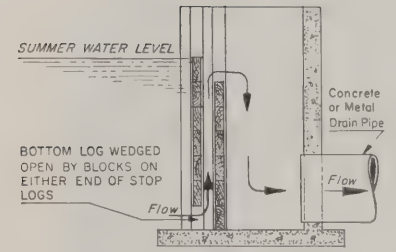
RECOMMENDED DESIGN OF DAM ON A TROUT STREAM

PLAN OF DAMSITE

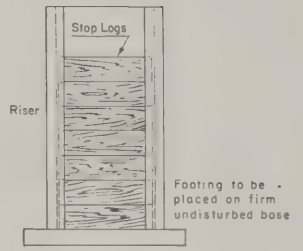


PROFILE OF DAMSITE

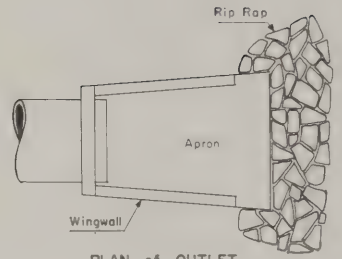




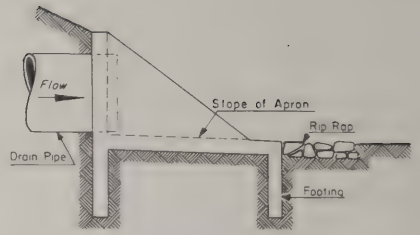
SECTION A–A



FRONT ELEVATION



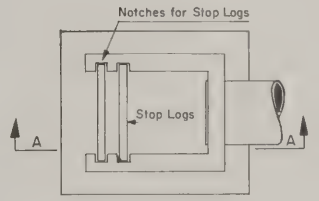
PLAN of OUTLET



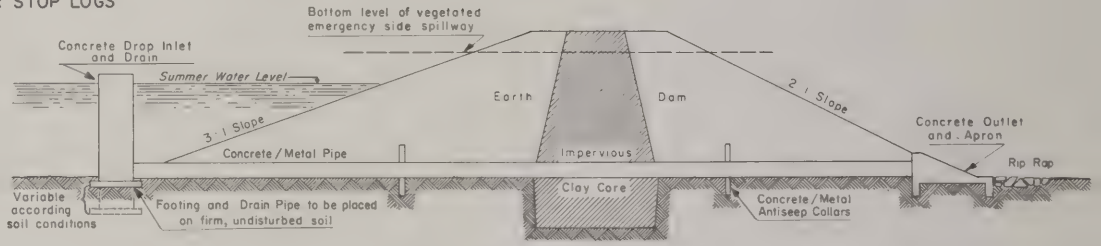
SIDE ELEVATION

DETAIL OF
CONCRETE OUTLET AND APRON

DETAIL OF
REINFORCED CONCRETE – BOX TYPE INLET
WITH DOUBLE NOTCH FOR STOP LOGS



PLAN of INLET



SECTION THROUGH EARTH DAM

CONSERVATION AUTHORITIES BRANCH, Dep't. E. & R.M., C.S.V. 1964

110 of these species remain to nest in the area. Almost all of the remainder are migrants, while a few, such as the Snowy Owl, the Arctic Three-toed Woodpecker and some members of the Fringillidae (the grosbeak and finch family) are winter visitors from the north country.

(a) Woody Plants

The mounting interest justifies the inclusion here of a list of species of woody plants which are particularly recommended as providing cover, browse or fruit for both birds and mammals. Common crop plants are discussed separately, and a few extra notes have been included concerning particular species of shrubs.

Woody Plants Recommended for Wildlife Use

(Exotic or Introduced Species are starred *)

SCIENTIFIC NAME	ENGLISH NAME	REMARKS
Alnus rugosa	Speckled Alder	Fruit; for wet places
Amelanchier canadensis	Juneberry	Cover, browse, fruit
*Caragana arborescens	Caragana	Useful cover in sandy areas
Crataegus sp.	Hawthorn	Fruit
Cornus Amomum	Silky Dogwood	Cover
Cornus stolonifera	Red Osier Dogwood	Cover
*Elaeagnus angustifolia	Russian Olive	Cover, fruit
*Elaeagnus umbellata	Autumn Olive	Cover, fruit
*Euonymus europaeus	Spindle Tree	Cover, fruit
Parthenocissus inserta	Virginia Creeper	Cover; climber
*Pyrus Aucuparia	European Mountain Ash	Fruit
Quercus rubra borealis	Northern Red Oak	Fruit
Rhus typhina	Staghorn Sumac	Cover, fruit
*Rosa multiflora	Multiflora Rose	Cover, fruit
Salix fragilis	Crack Willow	Cover on stream banks
*Salix purpurea	Purple Osier Willow	Cover on stream banks
Sambucus canadensis	American Elder	Browse, fruit
Thuja occidentalis	White Cedar	Cover, browse
Viburnum Lentago	Nannyberry	Cover, fruit
Viburnum trilobum	Cranberry Bush	Fruit
*Viburnum Opulus	European Cranberry	Fruit
Vitis vulpina	Frost Grape	Cover, browse, fruit

Some caution is required concerning the use of a few of the above species. The Frost Grape (or Wild Grape) provides excellent food and cover, but it forms such a dense tangle over fences and young trees that it should only be planted where it can be carefully watched and controlled. Hawthorn is an excellent plant for wildlife use, but it should never be planted close to permanent pasture, as it may rapidly spread from seed and is difficult to remove. Multiflora Rose is an excellent hedge-forming shrub, but it has a tendency in Ontario to die back in winter. It should be noted that even where it dies back it forms excellent cover for wildlife. Plantings from the nurseries of the Metropolitan Toronto and Region Conservation Authority have grown well since 1961 at Greenwood and Claremont, some miles from the lakeshore, and the species has even grown well at Palgrave, Mono Mills and in the Cold Creek Conservation Area, up to thirty miles from Lake Ontario. It grows best where the herbicide, Simazine, has been used to control competition and with a very light sprinkling of 10-10-10 fertilizer which should not be touching the plant.

(b) Common Crop Species

Hairy Vetch - This species can be grown on poor sandy soils, but it probably would not do well on the poorest soils (Pontypool sand) in Clarke and Hope Townships. Naturally, it will grow better on good soils. This species overwinters well. Cottontails and the European hare use it for food and cover. The seeds are eaten by a great many of the ground-feeding birds.

Crown Vetch can be grown successfully on almost any kind of soil. Its main use is for erosion control on steep slopes, as ground cover and for temporary grazing. It must be sown with a nurse crop. Available tests indicate it is hardy in Southern Ontario as far north as Peterborough.

Corn - A few rows of uncut corn standing in a field or garden will provide excellent cover and a continual supply of food for the larger birds. Cracked corn is useful for smaller birds. Corn left near streams will almost certainly be removed and eaten by raccoons and is often taken before it is ripe.

Buckwheat - This plant is chiefly grown for its abundant seed, which is mixed in with other seeds in feed mixtures. The seeds have a high fat content. The rest of the plant is normally ploughed under, particularly to increase the soil nitrogen. Much of the seed drops off in the stubble and buckwheat stubble is a favourite feeding ground for almost all birds.

(c) Herbicides

While Simazine has already been mentioned with respect to establishing Multiflora Rose, it should be remembered that there are now additional excellent herbicides which help in establishing trees and shrubs for wildlife.

From recent tests in the United States it appears that the most useful herbicides are the following:

(1) Amitrole and Amitrole T

Amitrole (amino triazole) is a 50 per cent wettable powder. Amitrole T is a liquid formulation containing ammonium thiocyanate. This additive increases the translocation of amitrole in plants and makes amitrole a more effective herbicide. A gallon of amitrole T contains two pounds of active amitrole and costs about $10.00. These formulations kill grasses and other herbaceous plants, working best when weeds are growing actively. Planting has only to be postponed for 14 days after treating the vegetation. These herbicides kill by destroying the plant's ability to make chlorophyll.

(2) Dalapon

This material, also a grass killer, has given good results when used in the fall or applied four weeks before planting shrubs in the spring. It has a long residual effect and does not break down as rapidly as amitrole T. When applied to grass it should be used at a rate of 15 pounds of actual dalapon per acre.

(3) Simazine

When applied to weed-free ground this herbicide produces a thin toxic layer on the soil surface and kills weeds as they germinate. This is an inexpensive chemical to use because it is active at low rates of application. Its effects in controlling competing weeds may last for several years.

On the other hand, it must be remembered that the widespread and injudicious use of herbicides can be severely detrimental to wildlife. There has been an alarming increase in the destruction of roadside vegetation by poisonous compounds and it appears that in some cases this has not been justified. It is recommended that the Authority urge the restriction of the poisoning of roadside vegetation to those areas where it is absolutely necessary. In some parts of the Ganaraska Region the roadside vegetation provides the only good wildlife cover.

3. Water

The importance of water to wildlife is often forgotten. Many farms have at least one low spot where a small amount of work with a scoop will create a

dam and a pond to provide nesting and feeding sites for water and marsh birds. A grassed spillway should be made with a lower level than the crest of the dam, in order to pass exceptional flows without damaging the dam.

If possible, ponds for wildlife should be separate from those intended for cattle or for fish. New water areas are usually invaded very rapidly by aquatic plants, but additional species may have to be introduced. No extensive duck food studies have been made in Southern Ontario. Wild Rice may be introduced but it cannot be considered as certain to succeed. The seed must be kept wet from the time that it is harvested until it is sown (or broadcast) on the water surface. The idea has long been current, and fostered by many sportsmens' organizations, that the growing of Wild Rice is the answer to the problem of attracting ducks to any area. This is a very important species where migratory wildfowl are wanted, but it does not provide good cover or nesting sites in Southern Ontario.

The following species which may be easily obtained are recommended as certain to be valuable duck foods. If none of them occur in ponds or shallows with good cover for ducks, they can be introduced. All of them are hardy in Southern Ontario.

Sago Pondweed	Potamogeton pectinatus L.
Red-head Pondweed	Potamogeton Richardsonii (Ar. Benn.) Rydberg
Wild Celery	Vallisneria americana Michx.
Wild Millet	Echinochloa crusgalli (L) Beauv.
Knotweed	Polygonum pensylvanicum L.
Water Smartweed	Polygonum coccineum Muhl.
Duckweed	Lemna sp. and Spirodela sp.
Buttonbush	Cephalanthus occidentalis L. (on wet shores)

Of the above species the most useful are Sago Pondweed, Wild Celery and Knotweed. Wild Celery grows best on a firm but fertile bottom in from 3½ to 6½ feet of water. A sluggish current suits it better than either stagnant or rapid water. It is not known to grow in strongly alkaline water.

Those who are interested in farm ponds for wildlife or for warm water species of fish will find very useful details of the various types of ponds and methods for constructing them in the booklet "Farm Ponds", published by the Ontario Department of Agriculture. It is frequently good practice to have separate ponds devoted to wildlife and fish and to control the aquatic plants in a fish pond.

In managing warm water ponds for fish the following points should be kept in mind:

(a) A minimum depth of 12 feet over at least 25 per cent of the pond should be planned to avoid excessive winter kill, probably the critical factor in fish survival in farm ponds in Ontario.

(b) If suckers, carp or large numbers of minnows are already present in the pond, it is usually best to destroy all fish in the pond before stocking.

(c) Since many of the species commonly recommended for introduction grow very slowly in Ontario waters, research to determine the most satisfactory species will be needed. New ponds and those in which the previous fish have been destroyed might be stocked experimentally with a combination of largemouth bass and the fathead minnow, which occurs in the watershed already.

The fertilizing of ponds for the increased growth of plankton (the smaller aquatic invertebrates) to provide food for fish should be approached with caution. Those considering the fertilizing of ponds should apply to the local District Biologist at Lindsay for advice.

Aquatic plants have various effects in ponds. They provide cover for the young of every species and they may be essential for the spawning of some species. In low densities they may encourage the development of invertebrate foods for fish. A blanket of Muskgrass, Chara sp., (one of the algae) over most of the pond bottom may maintain an important cool habitat in the water in hot weather. However, the merits of aquatic vegetation may be overshadowed by more important disadvantages. Little or no photosynthesis takes place beneath a layer of ice or snow. Plant decay will reduce the oxygen content of the water and this, with the resultant liberation of carbon dioxide, ammonia and hydrogen sulphide, may kill all or part of the fish population. If there is a partial kill, it is the game fish which will suffer most since they have higher water quality requirements.

Relatively shallow ponds are more susceptible to invasion by plants, and to remain suitable they should be kept reasonably free of weeds. The presence of higher aquatic plants in large quantities significantly decreases production of phyto and rotifer plankton*. The basis of a modern fish management program is adequate production of plankton and bottom fauna, with proper control of algae and the submersed and emergent plants.

4. Control of Aquatic Plants in Ponds

Considerable research has been carried out by the Ontario Water Resources Commission in the control of algae, particularly Cladophora, in Ontario. The Metropolitan Toronto and Region Conservation Authority has also carried out extensive research in the control of algae, the flowering submersed vegetation and emergent vegetation.

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* Hasler, E.D. and Jones, E. Demonstration of Antagonism of Large Aquatic Plants on Algae and Rotifers. Ecology, 30 (3), 1949.

Blooms of algae on the surface of ponds are not usually a problem in Ontario. Algae in ponds are often only present for a short time and will disappear in a month or so. It is recommended that the safest method of getting rid of algae is to treat the pond with a concentration of one part per million of copper sulphate, which should be dissolved in water and distributed uniformly over the pond. If there is no sign of disintegration or change in colour of the algae, then a second dosage of one part per million should be given in three or four days. If this is not successful, a third dosage should be given of the same concentration three or four days later. Under no circumstances should three parts per million of copper sulphate be applied in a single application.

The control of other submersed vegetation is a more difficult problem. A few years ago there were very few aquatic herbicides available. Sodium arsenite should not be used for this purpose, as it is dangerous from the point of view of public health. Safer compounds are now available. Endothal, Silvex, Fenac, 2-4-D, Diquat, Paraquat, Simazine and Atrazine provide a wide selection for control of most submersed weeds in farm ponds. New compounds are now frequently appearing on the market. They should be used strictly according to the directions on the labels, and never in greater concentrations.

Of the emergent vegetation, Cattails and most other species can be killed with Dalapon at rates of 10 to 15 pounds per acre.

It should be remembered that if there is any plan to treat aquatic vegetation with a chemical herbicide and the treated water flows into any other privately owned or public waters, it would be absolutely necessary to obtain a permit from the Ontario Water Resources Commission.

If there is doubt as to what the species of weeds are and how they may be controlled, a fair sample of the weeds should be placed in a quart sealer which contains a 5 per cent solution of formaldehyde, and the sealer should be sent to the Ontario Water Resources Commission, Toronto. The Ontario Water Resources Commission can also provide information as to where the recommended control products can be obtained in Ontario.

5. Recommended Procedure

It is recommended that the Authority acquire or construct at least two warm water ponds, one for fish and one for wildlife, and that the Authority demonstrate the described management techniques on each of these.